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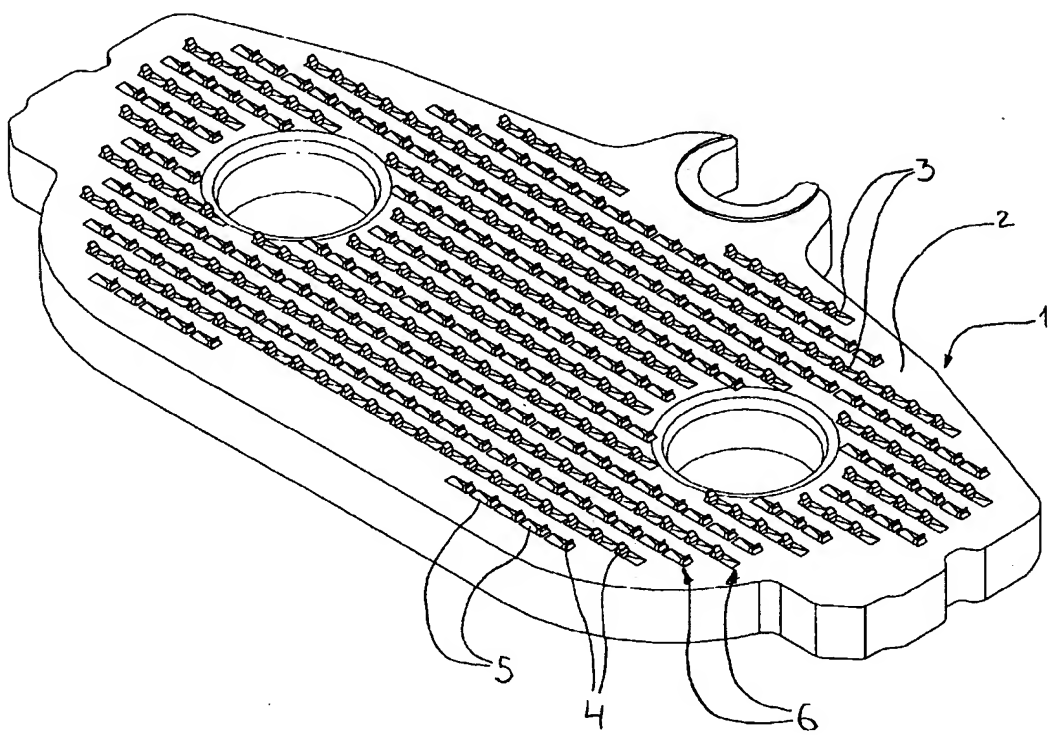
(54) **PORTE-SABOT D'UN FREIN A DISQUE, METHODE ET APPAREIL DE FABRICATION**

(54) **DISC BRAKE BACKING PLATE AND METHOD AND APPARATUS OF MANUFACTURING SAME**



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ABSTRACT

The invention includ s a plat for holding a friction material in a brake assembly. The plate preferably comprises a contact surface for attaching the friction material to the plate, a second surface opposing the contact surface; and a plurality of retaining structures formed on the contact surface, each retaining structure comprising a projecting member extending from a point between the contact surface and the second surface, so that the member extends outwardly from the contact surface for engagement with the friction material.

CA 02262214 1999-02-18

Title: **DISC BRAKE BACKING PLATE AND METHOD AND APPARATUS FOR MANUFACTURING SAME**

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BACKGROUND OF THE INVENTION

Field of the Invention

This invention relates to disc brakes for motor vehicles, and in particular to an improved disc brake backing plate, as well as a method and apparatus for manufacturing the backing plate.

Description of the Prior Art

Although disc brakes have been used on motor vehicles for many years, their use has increased substantially in recent years. In particular, there has been a significantly increased use of disc brakes on lower priced cars and trucks, with a consequent interest in methods of reducing the cost of manufacturing disc brakes and replacement parts therefor on the part of both motor vehicle manufacturers and suppliers of parts for disc brakes. This increased use has also led to a significant increase in the after-market for disc brake replacement and repair.

Disc brakes, as currently manufactured, combine two main parts, namely a backing plate and a friction pad. The backing plate is mounted in a brake assembly, and may be formed by stamping a suitable metal blank to produce a backing plate with a variety of bosses, holes, or other features for receiving and retaining the friction pad. The need to use high speed low cost manufacturing methods often results in irregularities in the backing plate which may lead to difficulties in attaching and/or retaining the friction pad on the backing plate during braking, when the friction pad is in contact with the rapidly turning brake rotor, or even during the pre-installation handling of the brake pad assembly.

There are a variety of known ways of attaching a friction pad to a backing plate. One such way is to attach the friction pad to the backing plates using rivets. One disadvantage of the riveting process is that it creates a rigid bond between the backing plate and the friction pad, which can, as a result of a sudden impact, lead to breaking of the friction pad. Furthermore, this process often requires one or more additional manufacturing steps with a consequent increase in cost. In addition, when the friction pad is worn down over time, the rivets become exposed and rub against the brake rotor, causing scoring on the rotor which is costly to repair.

Another, more recently developed method of mounting the friction pad on the backing plate is to use a pressurised molding process to mold the friction pad directly onto the backing plate. In this process, the friction pad may be prepared by blending the components of the friction pad into a pre-form or cake. A conventional pressurized molding system is used to mold the friction pad pre-form onto the backing plate. A layer of cement or glue if often applied to the contact surface of the backing plate to improve the adhesion between the backing plate and the friction pad.

As pressure is applied to the mold assembly, the pre-form becomes heated and begins to flow, filling the mold and covering the appropriate surface of the backing plate. In this process, the pre-form material is intended to flow into and around the various features to improve the bond between the backing plate and the friction pad.

The backing plate is subjected to a number of forces, such as the jarring of the moving vehicle, as well as vibration caused by the rotor and noise. The problem with the prior art processes and backing plates is that features, such as holes and bosses, stamped into the backing plate often provided insufficient shear and/or tensile strength in the bond between the

friction pad and backing plate. When additional featur s are stamped into the backing plate to increase bond strength, additional manufacturing steps are required, adding to the cost.

The most common prior art features stamped into backing plates are circular holes. These holes often provide unsatisfactory results because, during the molding process, the pre-form cake does not completely fill all of the holes, which in turn, leads to deficient bonding between the backing plate and the pre-form. The incomplete hole fills can are clearly visible, and often raise quality concerns when inspected by buyers. The incomplete hole fills also have an aesthetically displeasing appearance, which can also make them less attractive to customers. Accordingly, it has become common practice in prior art backing plates to fill the incomplete hole fills with putty and to paint over them, to both hide the unsatisfactory molding results and to improve appearance. These additional manufacturing steps have the added disadvantage of increasing the cost of manufacturing the disc brake.

Furthermore, the holes stamped by prior art processes reduce structural strength of the backing plate, and make it more vulnerable to the various forces acting on it. These forces may distort the shape of the backing plate, leading to uneven wear on the friction pad, or can lead to structural failure of the backing plate.

Accordingly, there is a need for a disc brake backing plate and a method of manufacturing same which can provide improved bonding with the friction pad without increasing the cost of producing the backing plate

SUMMARY OF THE INVENTION

It is an object of the invention to provide a backing plate which provides an improved bond between it and the friction pad, as well as increasing the structural strength of

the backing plate, without increasing the cost of producing the backing plate. In addition, it is an object of the invention to provide a method and apparatus for manufacturing the backing plate which reduces time and cost by requiring fewer manufacturing steps, while at the same time retaining the structural strength of the backing plate.

Further features of the invention will be described or will become apparent in the course of the following detailed description.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the invention may be more clearly understood, the preferred embodiment thereof will now be described in detail by way of example, with reference to the accompanying drawings, in which:

Fig. 1 is a perspective view of a preferred embodiment of a backing plate according to the present invention;

Fig. 1A is a detailed side view of area "A";

Fig. 2 is a perspective view of a preferred embodiment of an apparatus for manufacturing the backing plate according to the present invention;

Fig. 3A is a plan view of the apparatus;

Fig. 3B is a magnified view showing the knives and teeth of the apparatus shown in Fig. 3A;

Fig. 4 is an elevation view of the apparatus with the side plates removed;

Fig. 5A is a cross-sectional view showing the apparatus impacting the bottom of a conventional press;

Fig. 5B is a cross-sectional view showing the knives beginning to cut into a blank; and

Fig. 5C is a cross-sectional view showing the knives completing the cut into a blank.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows a disc brake backing plate **1** according to a preferred embodiment of the present invention. The backing plate **1** has a conventional shape and any suitable thickness ($^1/_8$ - ½ of an inch), and is preferably manufactured from metal or a metal composite adapted to withstand the rigors of a conventional disc braking system. The circular holes shown on the backing plate are not necessary are included for illustrative purposes only. The backing plate has a contact surface **2** for molding a friction pad (not shown) thereto by a conventional molding process.

Any suitable number of retaining structures **3** are connected to the first surface of the backing plate. Preferably, the retaining structures are integrally formed by punching the backing plate, as described in more detail below. Each retaining structure includes a burr **4** projecting out of the first surface, which is located adjacent to a corresponding depression **5** defined in the contact surface **2**. Preferably, each burr is integrally formed by cutting the burr out of the first surface of the backing plate, which creates the corresponding depression **5**. Each burr preferably has a curved shape, which curves away from its corresponding depression.

The retaining structures **3** are preferably arranged in longitudinally disposed substantially parallel rows **6**. Preferably, the position of the burr **4** and depression **5** is identical for each row, but alternates with adjacent rows, as shown in Fig. 1. Preferably, the number of rows is sufficient to cover substantially the entire surface area of the backing plate **1** in order to

provide maximum bond strength. The depth of the depressions and the height of the burrs depends on th bond strength required for a particular application.

The backing plate **1** according to the present invention does not need to be coated with an any adhesive to achieve the required bond strength with the friction pad.

The method of manufacturing the backing plate **1** according to the present invention comprises placing the backing plate on a flat surface under a conventional press and punching the contact surface **2** of the backing plate with a series of substantially parallel knives **10**. Referring to Fig. 2, the knives are preferably disposed substantially parallel to the longitudinal axis of the backing plate. Each knife has a plurality of preferably identical teeth **11** defined along a cutting edge thereof. Each tooth forms the depression **5** and burr **4** of one retaining structure **3**. The configuration of the teeth alternates from row to row, such that every other row has an identical configuration.

Fig. 2 shows the apparatus **12** for manufacturing the backing plate according to the present invention. The apparatus is mounted to a conventional press in any suitable manner for punching the backing plate **1**, as described above.

Referring to Figs. 2-4, the apparatus **12** includes a base plate **13** from which two side plates **14** are suspended by preferably four conventional screws **15**. Preferably, two transverse slide rods **16** are suspended from four support springs (not shown) which are each attached to one of the screws at one end and to an end of the slide rod at the other end. The slide rods are slidably secured to the knives **10** by preferably guide slots **17** defined in the knives, in which the rods locate. A biasing means, such as, for example, two return springs **18** are connected to each slide rod to bias the slide rods toward each other. A pressure plate **19** is disposed below the non-cutting edges of the knives. Preferably, a plurality of adjustment

springs **20** are disposed between the bas plat and the pressur plate to urge the two apart. Two block housings **21** ar mounted transversely onto the base plat adjacent to th dges of the knives. A drive block **22** is mounted on each block housing by a slide bolt **23** which is disposed substantially parallel to the longitudinal axis of the knives. A slide block **24** is slidably mounted in each housing adjacent to the drive block.

Fig. 5A shows the initial step of operation of the apparatus **12.** A conventional press (not shown) drives the apparatus **12** onto a backing plate blank **25**, such that the slide block **24** preferably impacts the bottom surface of the press **26** before the knives **10** impact the blank. The impact against the bottom surface of the backing plate drives the slide block up relative to the drive block **22**, causing the slide block sliding surface **27** to exert a force on the drive block substantially parallel to the longitudinal axis of the knives. This force causes each drive block to move alternate knives along their longitudinal axis. Because only alternate knives contact each drive block before impact, adjacent knives are pushed in opposite directions by each drive block. Preferably, the knives are moving before the blank contacts the knives.

Referring to Figs. 5B and 5C, the impact of the knives **10** against the blank **25** may be regulated by the adjustment springs **20** (shown in Fig. 2). The adjustment springs allow the apparatus **12** to be mounted on presses having different force specifications. The adjustment springs effectively ensure that a constant force is exerted against the knives, regardless of the force applied by the press. As the knives are pushed down into the blank, they also slide along the slide rods **16** parallel to their longitudinal axis, such that adjacent knives are moving in opposite directions as they cut. These simultaneous downward and sliding movements cause each tooth **11** of a knife to form one retaining structure **3**.

The apparatus is able to complete an entire backing plate in one punch. After

the press lifts th apparatus **12**, the slide block **24** is returned into its starting position by gravity, and the knives **10** and drive block **22** are returned to their starting positions by th slide springs **19**.

During the process of molding and securing the friction pad to the backing plate, the pre-form material is set into a mold and pressed against the backing plate. The material flows into and surrounds each retaining structure **3** to bond with the backing plate **1**. The retaining structures provide improved tensile strength, as well as providing improved shear resistance. The tensile and shear strengths can be varied by changing either the depth of the cut (i.e. the depression **5**), which also increases the height of the burr **4**.. These results are accomplished using a two step process, and without the need for additional features, such as holes, leading to a decreased manufacturing time and significant cost savings.

It will be appreciated that the above description relates to the preferred embodiment by way of example only. Many variations on the invention will be obvious to those knowledgeable in the field, and such obvious variations are within the scope of the invention as described and claimed, whether or not expressly described.

1. A brake backing plate for holding a friction material in a brake assembly, the plate comprising:
   (a) a contact surface, and
   (b) a plurality of parallel rows of integral retaining structures formed on the contact surface, each retaining structure comprising:
      (i) a projecting member extending outwardly from the contact surface for engagement with the friction material; and
      (ii) a depression surface abutting the projecting member, the depression surface extending into the contact surface and having a length at least double the length of the projecting member.

2. The plate of claim 1, wherein the area of the plate covered by retaining structures comprises an area approximately equal to the area of the friction material to be coupled to the plate.

3. The plate of claim 1 or 2, wherein the position of the retaining structures in the rows comprises a staggered configuration between adjacent rows.

4. The plate of claims 1-3, wherein the position of the projecting member and the depression of a retaining structure alternates between adjacent rows.

5. The plate of claims 1-4, wherein the contact surface is curved or substantially flat.

6. The plate of claims 1-5, wherein the plate comprises a disk brake backing plate.

7. The plate of claims 1-5, wherein the plate comprises a drum brake backing plate.

8. The plate of claims 1-7, wherein the retaining structures are formed by cutting the plate.

9. The plate of claims 1-7, wherein the retaining structures are formed by scoring the plate.

10. The plate of claims 1-9, wherein the projecting member is in the form of a burr having a curved shape, the burr curving away from the abutting depression surface.

11. The plate of claims 1-10, wherein the plate comprises a metal or a metal composite plate.

12. A brake pad for use in a brake assembly, the brake pad comprising:
   (a) a friction material; and
   (b) a brake backing plate coupled to the friction material, the plate comprising:
      (i) a contact surface; and
      (ii) a plurality of longitudinally disposed parallel rows of integral retaining structures formed on the contact surface, each retaining structure comprising a projecting member extending outwardly from the contact surface for engagement with the friction material, and a depression surface abutting the projecting member, the depression surface extending into the contact surface.

13. The brake pad of claim 12, wherein the depression surface has a length at least double the length of the projecting member.

14. The brake pad of claims 12-13, wherein the plate comprises a disk brake backing plate.

15. The brake pad of claims 12-13, wherein the plate comprises a drum brake backing plate.

16. The brake pad of claims 12-15, wherein the brake backing plate comprises a metal or a metal composite plate.

17. A method of manufacturing a brake backing plate for securing a friction material to a contact surface thereof, the plate comprising a contact surface for attaching the friction material to the plate, the method comprising forming a plurality of parallel rows of integral retaining structures on the contact surface, each retaining structure comprising:

(a) a projecting member extending outwardly from the contact surface for engagement with the friction material; and

(b) a depression surface abutting the projecting member, the depression surface extending into the contact surface and having a length at least double the length of the projecting member.

18. The method of claim 17, wherein the retaining structures are formed by cutting the plate.

19. The method of claim 17, wherein the retaining structures are formed by scoring the plate.

20. The method of claim 18, wherein the cutting is done by a plurality of knives, each knife having a cutting edge, the edge having a plurality of teeth connected thereto.

21. The method of claim 20, wherein each said retaining structure is made by one tooth.

22. The method of claim 21, wherein each tooth cuts the contact surface to form a projecting member and an abutting depression surface.

23. The method of claims 20-22, wherein adjacent knives move in opposing directions.

24. The method of claim 23, wherein adjacent knives cut rows of retaining structures so as to form a staggered configuration between adjacent rows.

25. The method of claims 20-24, wherein the knives cut projecting members in the form of a curved burr, the burr curving away from the abutting depression surface.

26. The method of claims 17-25, wherein the plate comprises a metal or a metal composite plate.

27. The method of claims 20-26, wherein the knives commence to move parallel to the contact surface prior to impact with the plate.

28. The method of claims 20-26, wherein the knives commence to move parallel to the contact surface upon impact with the plate.

29. An apparatus for manufacturing a brake backing plate having a plurality of retaining structures formed on a contact surface thereof for retaining a friction material, comprising:

a cutting means for cutting a plurality of parallel rows of integral retaining structures on the contact surface, each retaining structure comprising a projecting member extending from the contact surface for engagement with the friction material and a depression surface abutting the projecting member, the depression surface extending into the contact surface and having a length at least double the length of the projecting member; and

a driving means for impacting the cutting means and the contact surface of the plate to form the retaining structures.

30. An apparatus as in claim 29, wherein the cutting means forms adjacent pairs of parallel rows which are oriented in opposite directions.

31. The apparatus of claims 29-30, wherein the cutting means comprises a plurality of knives, each knife having a cutting edge, the edge having a plurality of teeth

connected thereto, each tooth forming one of the plurality of retaining structures upon impact with the contact surface.

32. The apparatus of claim 31, wherein the knives are positioned to comprise a staggered configuration between the teeth of adjacent rows.

33. The apparatus of claims 29-32, wherein the apparatus further comprises:

at least one drive member slidably connected to at least one side of each of the plurality of knives;

at least one slide member slidably connected to the drive member;

wherein during impact between the knives and the contact surface, the slide member is adapted to move away from the contact surface, the slide member being adapted to move the drive member generally parallel to the contact surface, the drive member being adapted to move the knives generally parallel to the contact surface.

34. The apparatus of claim 33, wherein the slide member comprises an inclined sliding surface, the sliding surface being adapted to move the drive member generally parallel to the contact surface upon movement of the slide member.

35. The apparatus of claims 33-34, wherein the at least one slide member comprises two slide members, the at least one drive member comprises a first and second drive member, and the at least one side of the each of the knives comprises a

first side and a second side, wherein first drive member is proximate to the first side of at least one knife, and the second drive member is proximate the second side of the remaining knives.

36. The apparatus of claim 35, wherein the first and second sides of alternate knives are proximate to the first and second drive members, respectively.

37. The apparatus of claims 31-36, wherein adjacent knives move in opposing directions upon impact with the contact surface.

38. The apparatus of claims 31-37 further comprising a return means for returning the knives to a starting position.

39. The apparatus of claim 38, wherein the return means is at least one spring attached to a first and second slide rod, the slide rods being located within a first and second guide slots defined proximate to the first and second side of each knife.

40. The apparatus of claims 31-39, wherein the plurality of knives are disposed longitudinally in relation to the plate.

41. The apparatus of claims 31-40, wherein the knives are substantially parallel to each other.

42. The apparatus of claims 31-41, wherein the plurality of knives are adapted to move generally parallel to the contact surface prior to impact with the plate.

43. The apparatus of claims 31-41, wherein the plurality of knives are adapted to move parallel to the contact surface upon impact with the plate.

44. The apparatus of claims 31-41, wherein the plate is stationary and the plate is punched by the knives.

45. The apparatus of claims 31-41, wherein the knives are fixed in the direction perpendicular to the contact surface, and the plate is driven onto the knives.

46. The apparatus of claims 31-45, wherein the impacting means comprises a press having a top movable portion and a bottom stationary portion.

47. The apparatus of any of claims 31-46, wherein the apparatus further comprises:

a base plate secured to the top portion of the press;

two side plates secured to the base plate, the side plates projecting downwardly therefrom;

a positioning means for maintaining the knives in proximate to each other; the positioning means being connected to the side plates;

a force adjustment means for adjusting the force of impact of the knives against the contact surface; and

wherein the first and second slide rods are suspended from the base plate.

48. The apparatus of claim 47, wherein the force adjustment means comprises a pressure plate generally parallel to the base plate and at least one spring disposed between the base plate and the pressure plate, the pressure plate being connected to the knives.

49. The apparatus of claims 35-48, wherein the first and second sliding members impact the bottom portion of the press prior to the knives impacting the contact surface, thereby causing the knives to move generally parallel to the contact surface prior to impact of the knives against the contact surface.

50. The apparatus of claims 35-48, wherein the first and second sliding members impact the bottom portion of the press substantially simultaneously with the knives impacting the contact surface, thereby causing the knives to move generally parallel to the contact surface substantially simultaneously with impact of the knives against the contact surface.

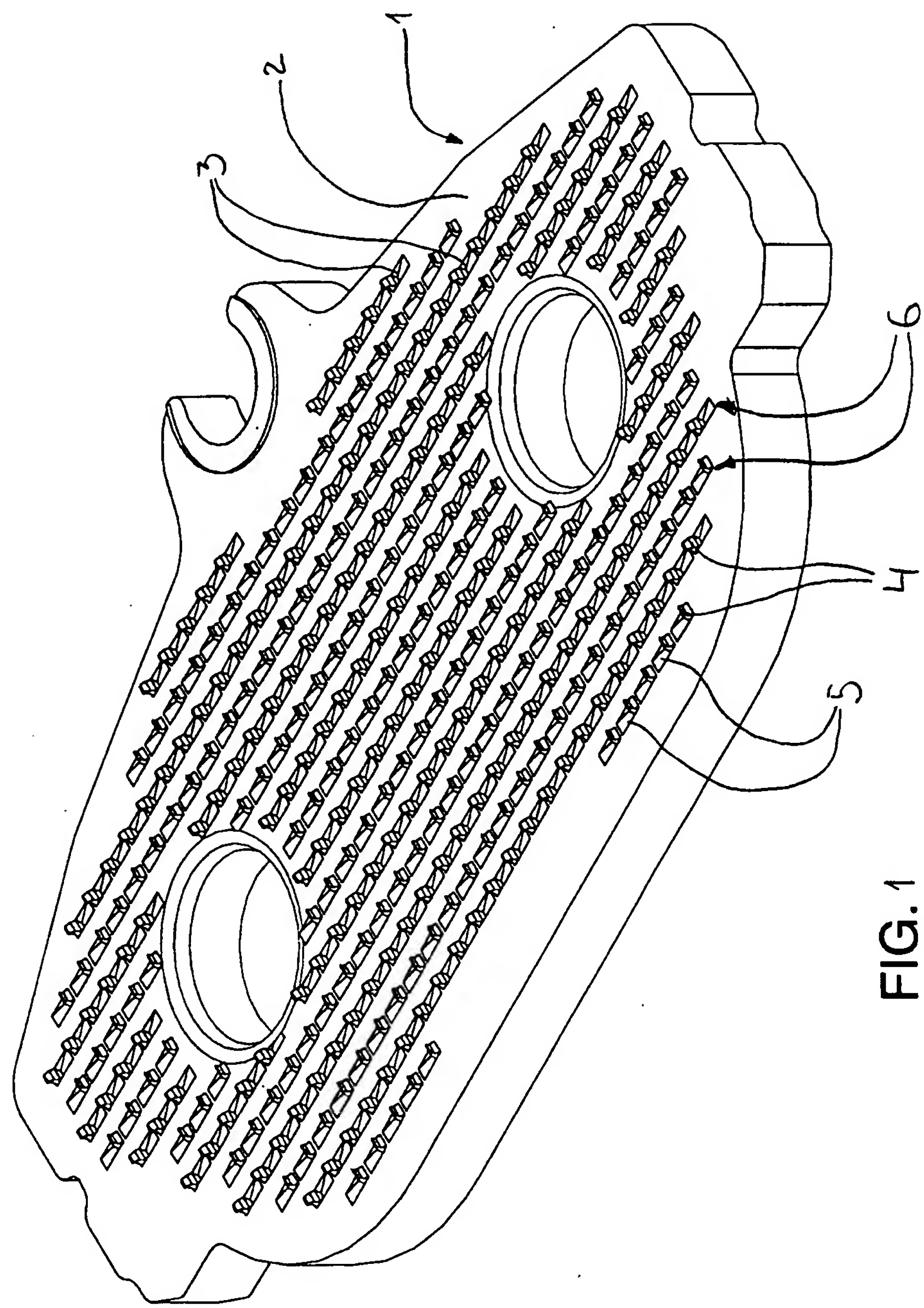

FIG. 1

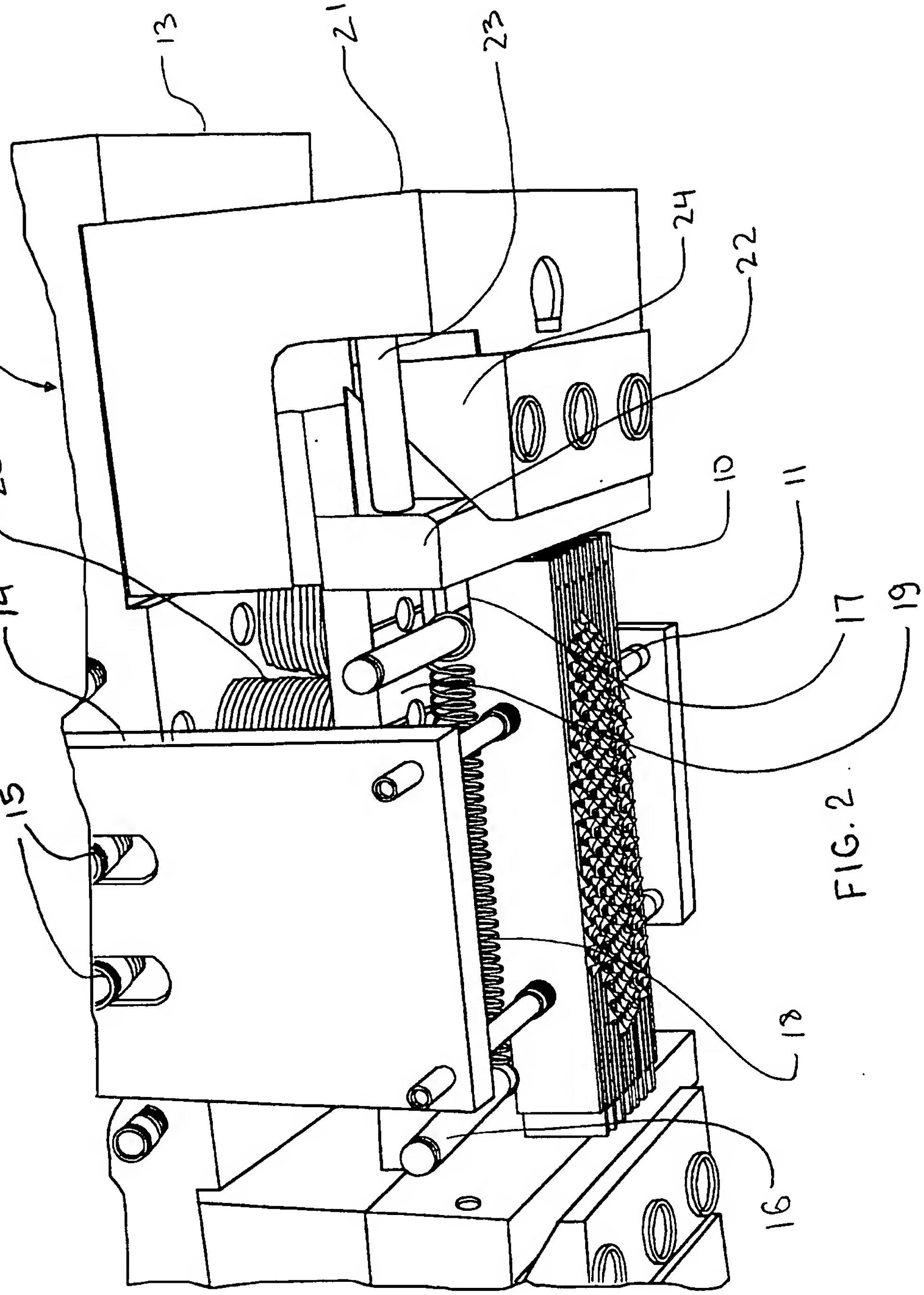

FIG. 2

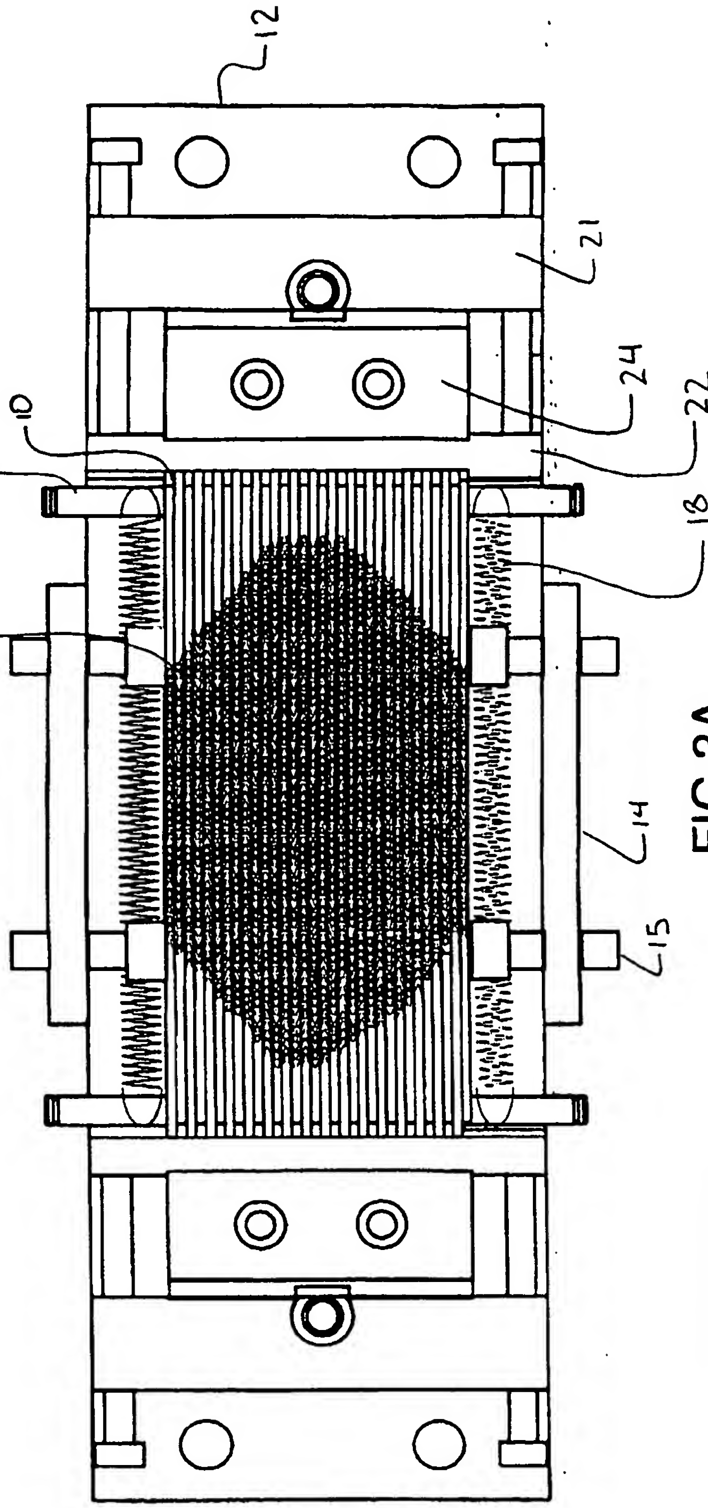

FIG.3A

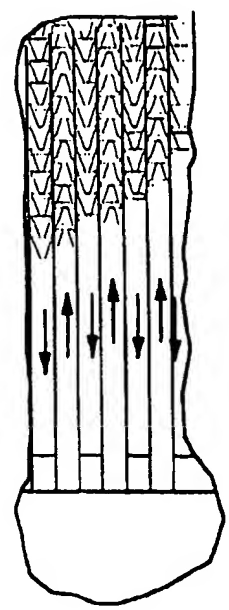

FIG.3B

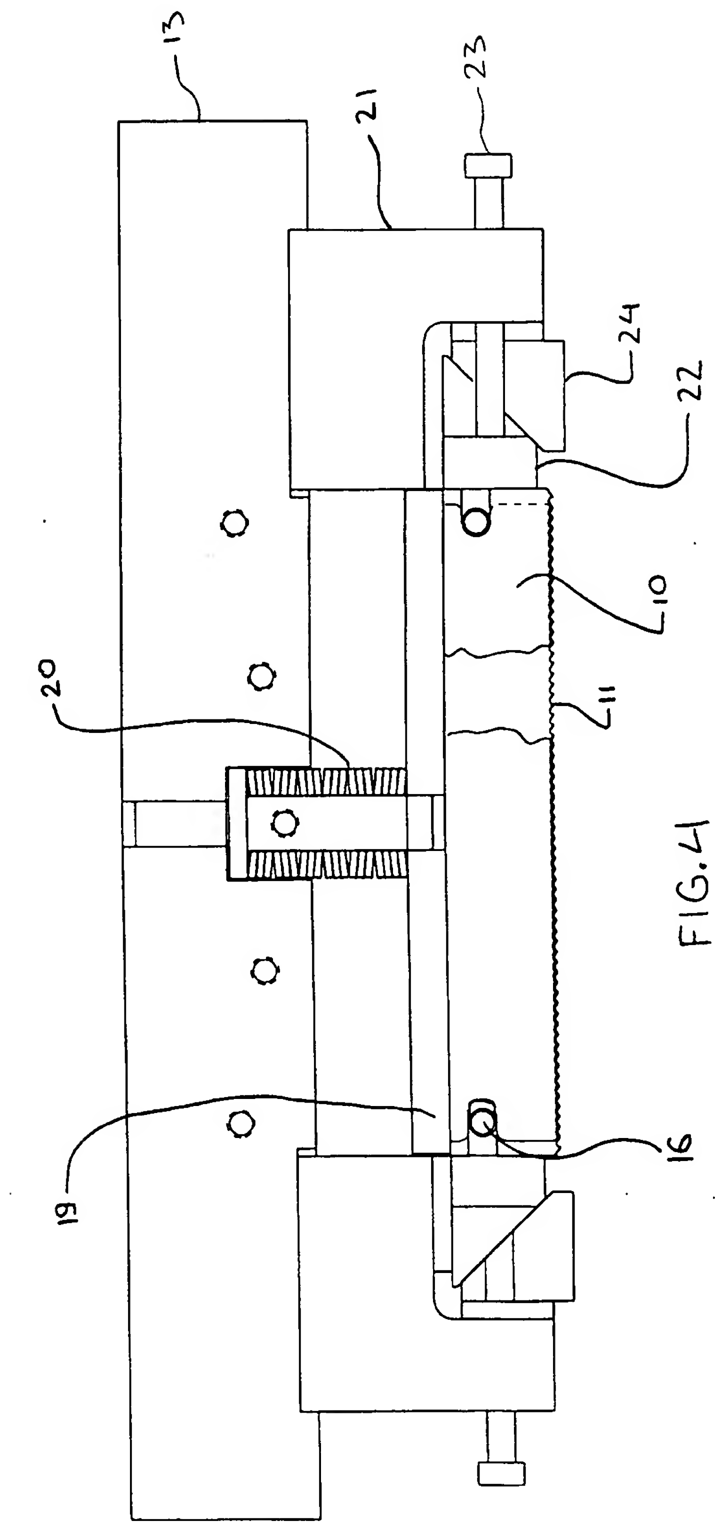

FIG. 4

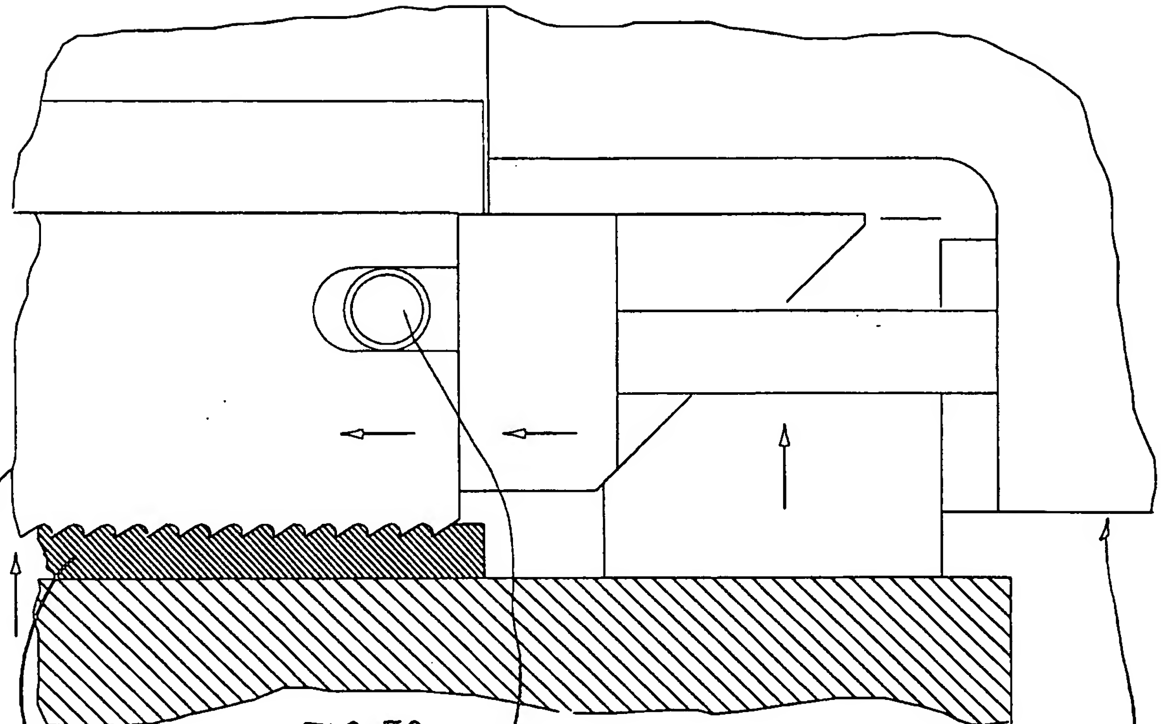

FIG. 5C

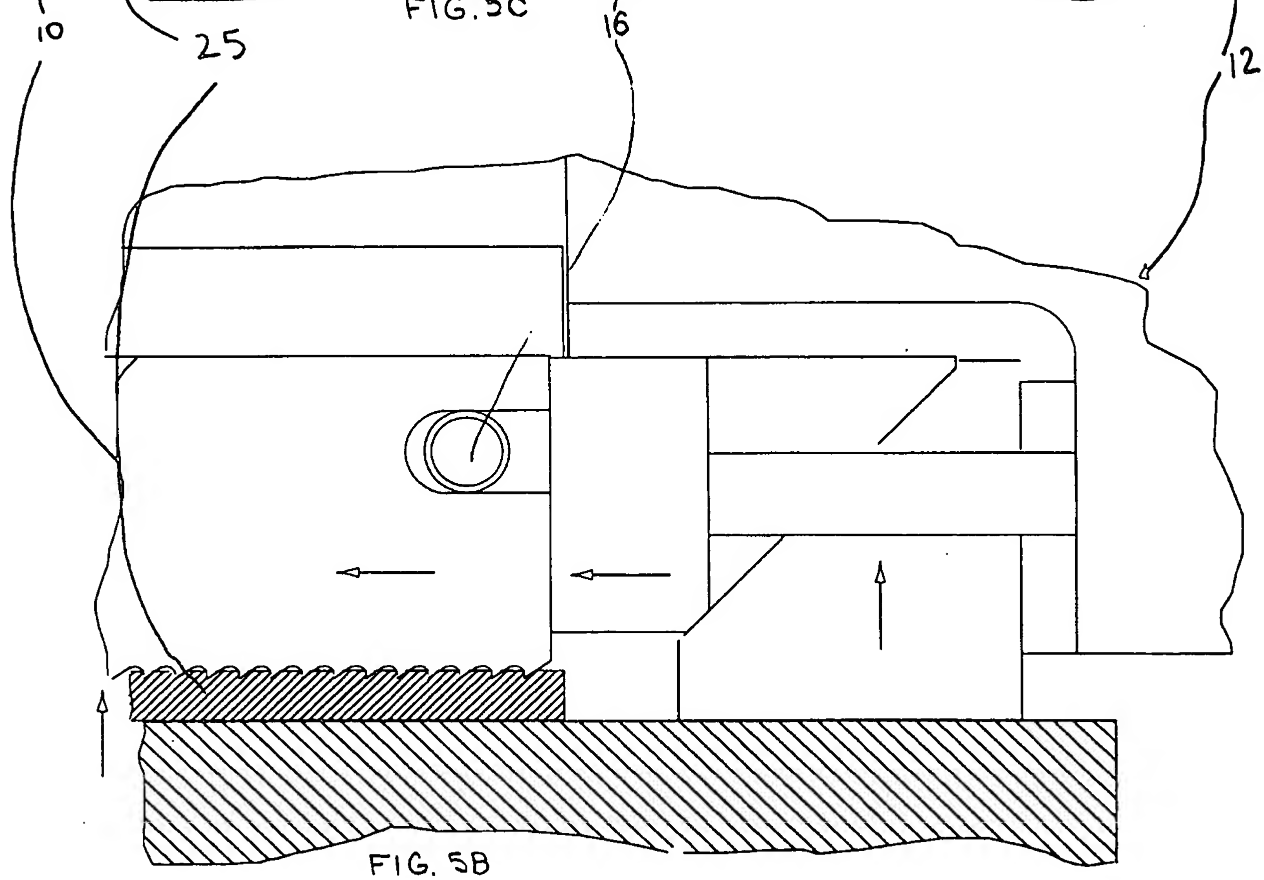

FIG. 5B

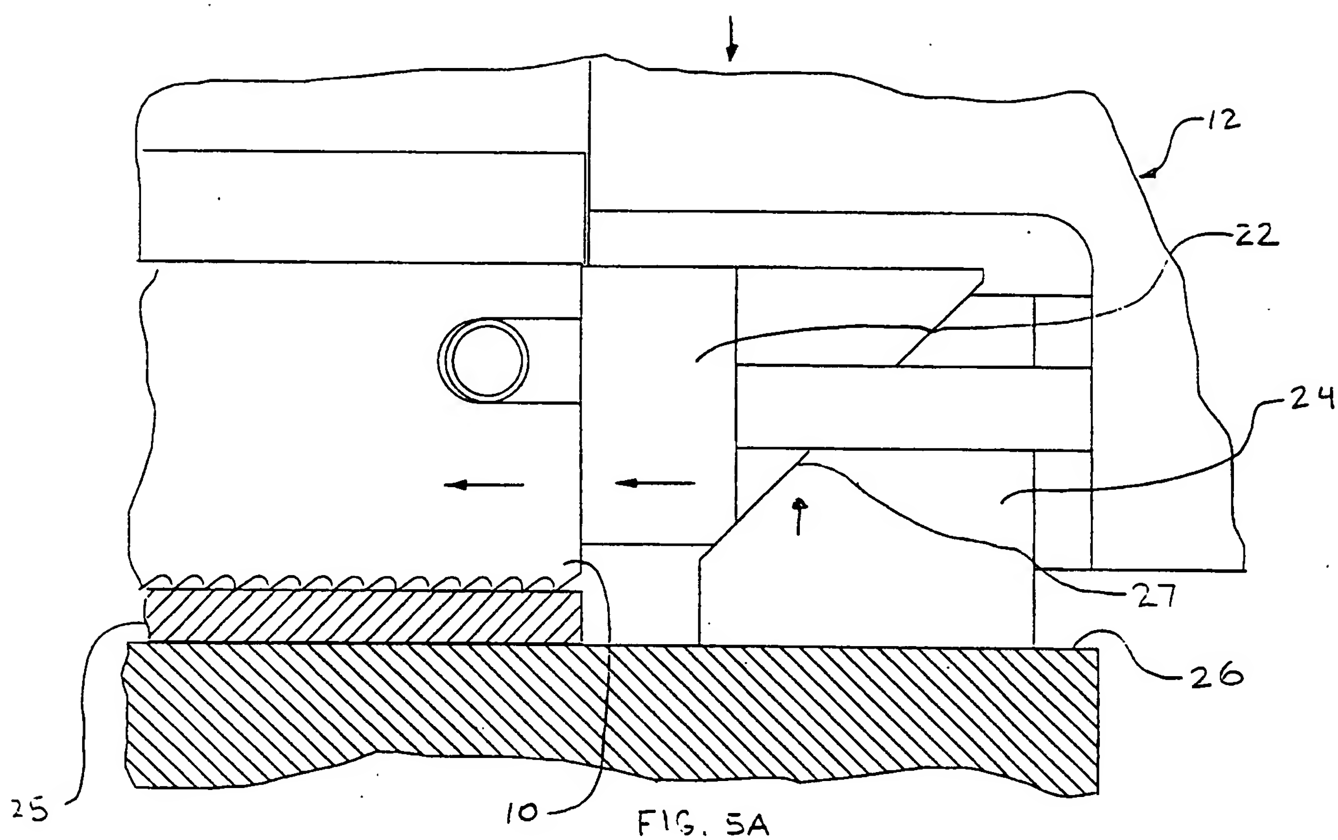

FIG. 5A